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An analysis of feed distribution systems for cattle

Robert Norman Anderson
Iowa State University

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Robert Norman Anderson

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CHAPTER I: INTRODUCTION

Cattle feeding is an important part of Iowa's agricultural economy. In 1978, Iowa's farmers received $2.56 billion from cattle and calves marketed, up 43 percent from 1977. This amounted to 31.1 percent of the cash income to Iowa farmers (3). Studies show that cattle producers are not the only people who benefit from cattle marketings. As an example, it has been noted that each dollar of livestock sales generates an additional $2.25 dollars of revenue for feed and pharmaceutical companies, equipment manufacturers, and packing and processing plants (1).

Table 1 shows the number of feedlots and fed cattle marketed by size of feedlot capacity in Iowa for 1976 and 1979. We see that the number of cattle feedlots in all lot sizes between 1,000 and 7,999 head have increased. While this increase was taking place, feedlots of less than 1,000 head were becoming fewer. Even though the number of lots with 8,000 or more cattle decreased by two, the average number of cattle fed in this largest group increased from 8,500 head in 1976 to 19,375 head in 1979 (3).

Table 1. Number of feedlots and fed cattle marketed by size, Iowa (3)

Capacity	1976		1979	
	# of lots	Fed cattle marketed (thousand)	# of lots	Fed cattle marketed (thousand)
under 1,000	32,784	2,506	31,518	1,820
1,000-1,999	94	84	334	440
2,000-3,999	88	135	106	280
4,000-7,999	24	92	34	195
8,000-over	10	85	8	155
Total	33,000	2,905	32,000	2,890

The job of feeding cattle in a feedlot has long been a physically strenuous task. Many feed distribution systems in the distant past consisted of little more than carrying feedstuffs to their cattle in a bushel basket. Today, however, cattle feeders use a variety of feed distribution systems and feed storage systems which enable them to feed more cattle than before and with less physical effort.

The many choices of feed storage and distribution systems give farmers an opportunity to evaluate the costs and benefits of each when making a decision about which system to select. The system selected has its basis in many criteria, the facilities on hand, available capital, labor, forages, etc. This study seeks to provide information relevant to making decisions about feed distribution systems for cattle within the framework of selected rations.

Objectives

The overall objective of this study is to develop guidelines which will be useful to Iowa farmers in selecting feed distribution systems for their cattle feeding operations. The specific objectives are:

1. to determine what kinds of systems Iowa cattle feeders are now using to store and distribute feedstuffs,
2. to establish costs for storing cattle feedstuffs in various storage structures,
3. to develop investments and costs for various feed distribution systems,
4. to construct feed distribution system budgets,
5. to make recommendations about optimal feed storage and distribution systems by size of feedlot.

Study Assumptions

In developing optimal feed distribution systems, it was necessary to specify the number of cattle fed and the ration to be fed.

Cattle numbers

Five levels of cattle feeding are considered with the levels being 100, 250, 500, 1,000 and 2,500 head fed and marketed per year. Feed distribution systems will be evaluated for each of these sizes.

Available rations

The cattle could be fed any one of the six rations found in Table 2. Each ration prescribes certain feed storage and distribution systems.

Table 2. Feed rations for cattle (5)

Ration number	Feed required	Rate of gain
1	6 tons corn silage 300 lb. supplement	Feed for 300 days 600 lb. gain
2	3 tons corn silage 37 bushels corn (dry or H-M) 261 lb. supplement	Feed for 261 days 600 lb. gain
3	2 tons silage 50 bushels corn (dry or H-M) 240 lb. supplement	Feed for 240 days 600 lb. gain
4	3/4 ton hay 56 bushels corn (dry or H-M) 261 lb. supplement	Feed for 261 days 600 lb. gain
5	1 1/4 tons haylage 42 bushels corn (dry or H-M) 180 lb. supplement	Feed for 180 days 450 lb. gain
6	3 tons corn silage 27 bushel corn (dry or H-M) 180 lb. supplement	Feed for 180 days 450 lb. gain

Procedure

Farm visits were conducted in the Spencer, Iowa area to develop background material for this study. A random sample telephone survey was conducted of all Iowa cattle feeders to determine current production practices and feed storage and distribution systems. A mail survey of known silo manufactures was conducted to obtain silo storage costs. All information was reviewed and organized into feed distribtuion systems. Machinery and equipment costs were obtained from machinery dealerships with the most often quoted price being used. Enterprise budgets were constructed to estimate feed distribution system costs.

Factors Affecting Feed Distribution Systems

Items which may affect feed distribution systems include the number of cattle fed and marketed per year, ration selection, available capital, and existing facilities.

Number cattle fed

Feed distribution systems may vary according to how many cattle are fed per year. Farmers who feed 50 to 100 head of cattle per year will have different cost structures than those who feed 1,000 to 2,500 head per year. This causes smaller feeders to adopt different storage and distribution systems than larger feeders. Smaller operators are often in a better position than larger operators to utilize existing facilities, and use family labor. Large operators may be able to obtain volume

discounts on supplies and equipment along with the associated favorable scale economies.

Available capital

Agriculture is capital intensive. Without adequate financing most cattle feeders would be unable to operate. Machinery costs make up a large portion of the cattle feeder's expenses. The capital position of the farmer may direct the cattle feeding system adopted. For example, a cattle feeder with nearly limitless capital may feed his cattle by automation while a cattleman with limited capital may distribute feed to his cattle by hand methods.

Facilities

Existing facilities found on farms are often used by cattle feeders instead of constructing new ones. Even though these are less efficient the cash flow problem is reduced and net returns may be higher due to lower fixed costs associated with existing facilities. Remodeling and updating of facilities often takes place after the operator has been feeding cattle for several years and saved enough money to finance the added investments of the new improvements. The major point is that the facilities selected are often modified by existing structures and not the same as if the operator had free selection.

Rations

The rations presented in earlier discussions show the need for various combinations of storage structures. Those rations requiring

all silage would not need grain storage facilities and those rations without silage would not require a silo.

Research has shown that high moisture corn has a better feeding value than heat dried corn (2). This study, however, is not involved with the economics of feeding wet or heat dried corn. This analysis will be left to other researchers.

CHAPTER II: FEED STORAGE AND DISTRIBUTION SYSTEMS IN USE BY IOWA CATTLE FEEDERS

Two procedures were used to determine the cattle feed distribution systems actually being used. First, farm visits to cattle feeders in the Spencer area were conducted and second, a telephone survey was conducted on a sample of 335 Iowa cattle feeders.

Spencer Area Trip

Five cattle feeders, each with a different philosophy of feeding cattle were visited. After viewing their cattle feeding operations, the farmers were asked to comment about how they liked their existing systems, how well their systems worked, what changes they would like to make and how they selected their final feed distribution system. This information was reviewed and used to help construct the cattle feeding telephone survey and to guide other analyses.

Telephone Survey

A telephone survey was selected over other survey techniques because its cost was relatively low and the response rate good. A farm visit survey was rejected because of its high cost.

The sample group of farmers to be contacted was statistically obtained through a farm organization where cattle feeders could be identified. The list included nearly all cattle feeders in Iowa. The contact sample was randomly selected by a uniform measurement of file space. The file was grouped by county. This organization, while being

rather complete, was more complete in some counties than others. Hence, several counties had no contacts and some counties had numerous contacts relating to how strong the local organization was.

The survey was first tested on four cattle feeders in the Newton, Iowa area. These farmers responded as to what they thought of the survey, the ease of answering questions and the conciseness of the interview.

The survey was improved and used in telephone interviews with 335 farmers with 292 surveys completed, for a 87 percent response rate. Undergraduate students from Iowa State University were selected to help conduct the survey. Each telephone visit took approximately 20 minutes to complete. However, some farmers had to be contacted several times because they were not able to complete the survey on the first call.

Survey results were tabulated with the help of the Iowa State University Statistical Laboratory. The survey was used as a guide in constructing the cattle feed distribution systems.

Telephone Survey and Results

A copy of the telephone survey is found in Appendix A of this study.

Table 3 shows the average number of telephone contacts for each of the nine Iowa Crop Reporting Districts. The three districts with the most contacts were Central, West Central, and Northwest.

Table 3. Average contacts per Iowa crop reporting district

District	Average contact per county
Northwest	3.8
North central	2.2
Northeast	1.9
West central	2.9
Central	4.1
East central	3.0
Southwest	2.0
South central	2.8
Southeast	2.4

Figure 1 shows a map of Iowa separated into the nine crop reporting districts, with telephone contacts shown within each county boundary.

Results of each survey question are shown next. Where practicality permits, each response is shown. Those questions with large numbers of different responses will show the range of answers, the 50 percent cumulative value (median) and the most frequent response (mode). The heading titled Responses, shows the number of farms indicating yes to a specific question. Questions with the range, median, and mode answers show only their respective values. For example, question 1 asks how many heifer calves did you sell in 1978? The answers ranged from two to 900 head, the median response was 65 head and the mode was 200 head. Question 2 shows the possible answers to the question, "What grade were the heifer calves finished to?" The answers were grade 1 with 16 farms, grade 2 with 127 farms, grade 3 with seven farms, and grade 4 with four farms answering yes to the question.

Answers to the same question for different classes of cattle were grouped into tables. Hence the questions are not all shown in questionnaire sequence. But the answers can be more meaningfully interpreted and compared. The survey results follow.

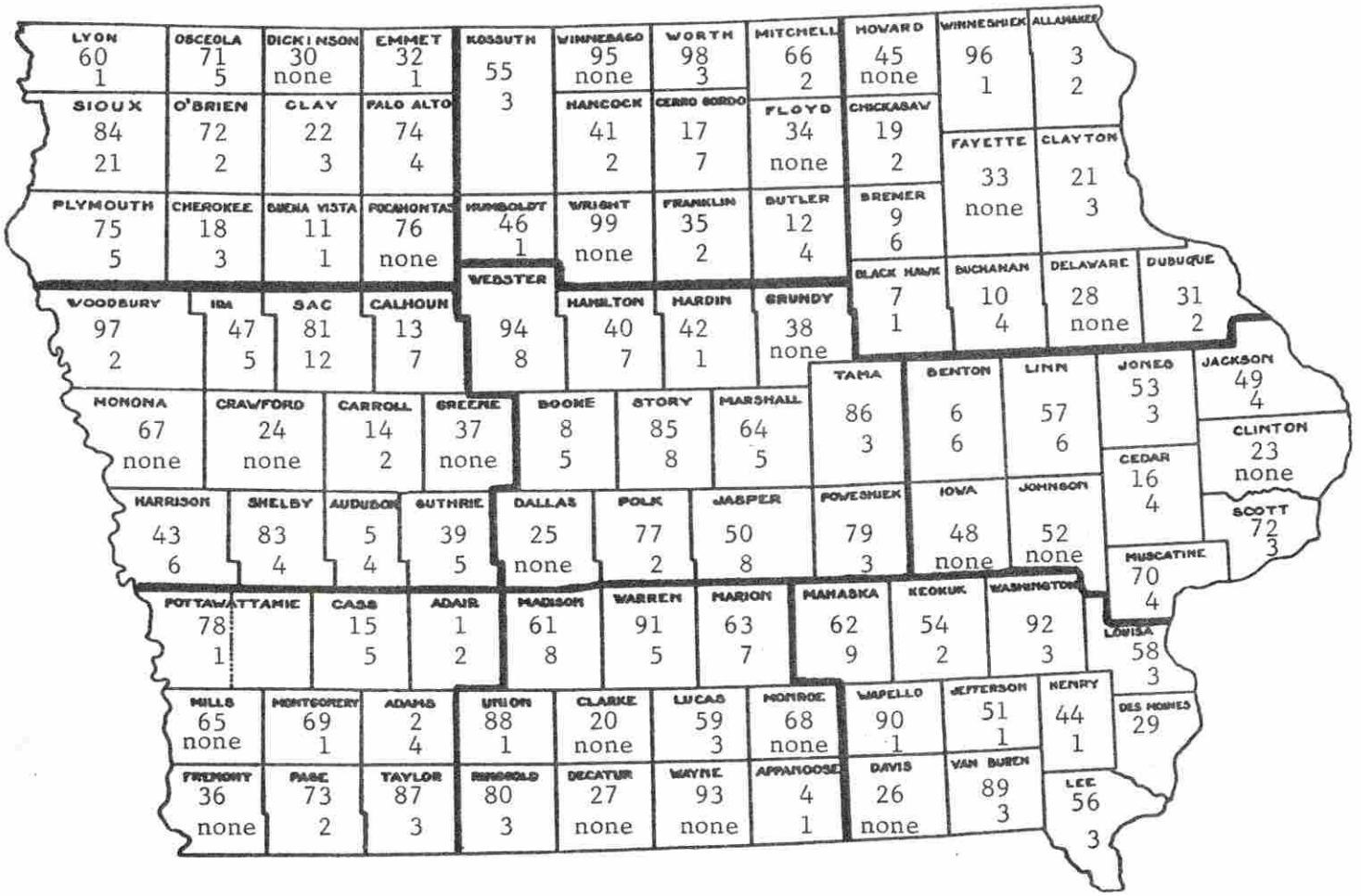

Figure 1. Iowa map showing crop reporting districts and number of telephone survey contacts made in each county (bottom number) and county number (top number)

Questions 1, 6, 11, and 16. How many market cattle did you sell in 1978?

Cattle type	Number of cattle marketed		
	Range	Median	Mode
Heifer calves	2-900	65	200
Steer calves	2-1200	84	50
Heifer yearlings	10-1500	90	100
Steer yearlings	4-5500	200	125

Questions 2, 7, 12, and 17. What market grade were the cattle finished to?

Cattle type	Number of farms by market grade			
	1	2	3	4
Heifer calves	16	127	7	4
Steer calves	10	133	10	6
Heifer yearlings	5	51	4	0
Steer yearlings	7	10	7	0

Questions 3, 8, 13, and 18. What month were the cattle placed on feed?

Cattle type	Number of farms by month												
	1	2	3	4	5	6	7	8	9	10	11	12	Continuous
Heifer calves	25	3	11	6	3	3	2	3	6	18	36	22	15
Steer calves	17	8	13	8	1	3	2	5	8	21	29	27	14
Heifer yearlings	7	4	5	2	1	5	2	2	5	11	8	8	8
Steer yearlings	10	5	5	7	1	2	5	9	3	16	21	16	22

Questions 4, 9, 14, and 19. Where were the cattle fed?

Cattle type	Number of farms by location of feedlot		
	Own farm	Rented farm	Combination
Heifer calves	113	29	11
Steer calves	119	27	14
Heifer yearlings	47	6	8
Steer yearlings	99	11	13

Questions 5, 10, 15, 20, and 21. What weight were the cattle placed on feed in pounds?

Cattle type	Weight in pounds		
	Range	Median	Mode
Heifer calves	75-800	450	450
Steer calves	80-800	490	500
Heifer yearlings	280-800	600	600
Steer yearlings	400-950	680	700

Question 22. How many times are the cattle fed per day?

	Responses
1	80
2	180
3	6
Self-feeding	23

Question 23. How many years have you fed cattle?

Range	1-60 years
Median	16 years
Mode	20 years

Question 24. What type of cattle feeding facilities do you presently have?

Open lot with	Responses
Feeding apron, windbreak, building	46
Feeding apron, windbreak	59
Feeding apron, building	55
Feeding apron	23
All concrete, windbreak, building	11
All concrete, windbreak	9
All concrete, building	27
All concrete	3
No concrete, windbreak, building	3
No concrete, windbreak	9
No concrete, building	9
No concrete	13
Windbreak, building	3
Windbreak	10
Building	10
Solid floor confinement	None
Slatted or flush floor confinement	1

Question 25. Do you have any roughage storage facilities?

	Responses
Yes	237
No	55

Questions 26, 28, 30, and 32. How many silos are on your farm by type?

	Number of silos					
Silo type	1	2	3	4	5	6
Concrete stave	56	57	14	6	1	1
Poured concrete	10					
Steel silos	16	10	8			
Bunkers	82	8	4			

Questions 27, 29, 31, 33, and 36. Roughage storage capacity of your silos in tons.

	Size of silo in tons		
Silo type	Range	Median	Mode
Concrete stave	100-4000	445	300
Poured concrete	22-949	220	*
Steel silo	50-2600	478	445
Bunker silo	80-9500	900	1000
Other	12-7000	400	300
Total	12-9500	730	500

*No two silos were of the same size.

Question 37. What type of corn storage do you use?

Type	Responses
Ear corn crib	120
High moisture structure	68
Take to town	45
Acid treatment	8
Bin	182
Other	23

Question 38. What type of supplement storage do you use?

Type	Responses
Steel bin	146
Building	53
Liquid	22
Bag	77

Question 39. What is your total supplement storage in tons?

Range	1-40 tons
Median	6 tons
Mode	3 tons

Question 40. What type of hay storage do you have?

	Responses
Barn	190
Overhead protection	31
No overhead protection	122
Other	4

Question 41. What type of bales do you use for hay?

Type	Responses
Small bales	188
Large round bales	129
Stacks	36
Other	3

Question 42. What type of feed distribution system do you use for your cattle?

	Responses
Push button auger from silo to fenceline bunks	7
Push button auger from silo to inlot bunks	72
Push button auger from silo to fenceline and inlot bunks	3
Silo to unloader wagon to fenceline bunks	39
Silo to unloader wagon to inlot bunks	34
Silo to unloader wagon to fencelines and inlot bunks	12
Bunker to unloader wagon to fenceline bunks	36
Bunker to unloader wagon to inlot bunks	38
Bunker to unloader wagon to fenceline and inlot bunks	16
Grinder mixer to fenceline bunks	6
Grinder mixer to inlot bunks	36
Grinder mixer to fenceline and inlot bunks	2
Other to fenceline bunk	14
Other to inlot bunk	30
Other to fenceline and inlot bunk	3

Question 43. How do you extract the roughage from the bunker?

Extraction	Responses
Payloader	8
Tractor with loader	92
Skid steer	6
Silage slicer	None
Moveable fence	2
Other	None

Question 44. Where are the roughages and supplements mixed?

Where	Responses
Feedbunks	49
Feeder-auger wagon	136
Grinder-mixer	40
Auger system	54
Other	26

Question 45. How was your feed distribution system selected?

	Responses
On farm and still used	97
Designed feed system for cattle	107
Determined number cattle to feed and then designed system	90

Questions 46-67. How many acres of each crop did you raise on both owned and rented farms in 1978?

	Acres of crops raised								
	Owned			Rented			Total		
	Range	Median	Mode	Range	Median	Mode	Range	Median	Mode
Corn	2-2500	145	150	15-1350	150	150 & 200	2-3000	230	150 & 200
Silage	5-700	30	30	8-300	35	20	5-700	33	20
Haylage	6-250	28	40	5-62	17	15	5-200	28	40
Hay	3-300	25	20	5-425	19	20	3-600	27	20
Oats	6-125	20	20	10-100	27	20	6-160	23	20
Rotated pasture	10-600	40	40	17-250	25	30	10-600	35	30
Permanent past	2-1200	55	20	4-1400	40	20	2-1900	54	20
Total acres							41-3600	365	200

Question 68. What type of leases do you have for your rented farmground and facilities?

	Responses
Crop share	93
Cash rent	66
Crop share and cash rent	36
Livestock share	15
Other	1

Questions 69-70. How many hours does the operator and his family work on the farm per week and how many hours are spent feeding the cattle per day?

	Number of farms by hours worked per week			Number of farms by hours spent feeding cattle					
	Over 40	20-40	Under 20	1	2	3	4	5	6
Operator	269	9	4	98	115	33	9	7	1
Spouse	9	35	77	7	1	1			
Children	50	39	55	38	18	9	4	1	

Question 81. Do you have any paid help on your farm?

Yes - 66

Question 82. If you have paid help, how many do you employ, how many hours per week do they work, and how many hours per day do they spend feeding cattle?

	Hours worked per week			Hours per day feeding cattle				
	Over 40	20-40	Under 20	1	2	3	4	5
Worker #1	41	16	3	6	14	6	6	2
Worker #2	14	2	0	1	4	1	3	1
Worker #3	4	1	0	0	0	0	0	0
Worker #4	3	0	0	0	0	0	0	0

Questions 24, 42, and 45 are of particular importance to this study. Question 24 asked, "What type of cattle feeding facilities do you presently use on your farm?" Answers were separated into three major groups: all concrete, no concrete, or feeding apron. The following four responses could also be included for open lot systems; a wind-break, building, both, or neither. The farmer could indicate he used either a building, a solid floor confinement unit, or a slatted, flush floor confinement unit. This question helped us to effectively design feed distribution systems. Due to the large number of responses within the feeding apron group (62 percent of the completed surveys) the feed distribution systems were designed for the feeding apron system, but they could be adapted for either a all-concrete or no-concrete system.

Question 42 asked, "What type of feed distribution system do you use for feeding cattle?" The responses to this question were again used to help design the feed distribution system enterprise budgets.

Question 45 showed whether the feed distribution system was on the farm when the operator began feeding cattle and is still being used, whether the farmer designed the feed distribution system for the number of cattle to be fed, or if the farmer determined the number of cattle he wished to feed and then adapted the feeding system to it. This question showed whether a farmer used facilities found on his farm, or if he designed the feed distribution system. Sixty-nine percent of the farms designed their feed distribution facilities while 31 percent used existing facilities found on their farms.

Tables 4 to 6 show other survey highlights which are of interest in this study.

Table 4. Average weight and most frequent placement months for cattle

Type of cattle fed	Average weight placed on feed	Most frequent placement month
Heifer calves	445 pounds	October-January
Steer calves	495 pounds	October-January
Heifer yearlings	575 pounds	November-December
Steer yearlings	690 pounds	November

Table 5. Number of times cattle fed per day by percent

Number of time cattle fed per day	Percent
One	27
Two	67
Three	2
Self-feeder	8

Table 6. Number of roughage storage structures on farms including average capacities

Silo type	Number of farms having silos	Total average capacity (tons)
Concrete stave	157	445
Poured concrete	10	220
Steel	37	478
Bunker	94	900

Farm size ranged from 42 to 3600 acres, the average number of years a farmer had fed cattle was 16, ranging from one to 60 years.

CHAPTER III: FEED STORAGE COST

Silo capacities and storage costs were determined through a letter of inquiry sent to 39 mid-western silo manufacturers. Of the 39 inquiries sent, 16 were returned for a 41 percent response rate. Each silo manufacturer was asked to provide information concerning storage capacities and construction costs for three silo types: concrete stave, high moisture, and bunker.

Table 7 shows the number of inquiries sent and the number responding to each of the three silo types.

Table 7. Silo manufacturers response rate for three silo types

Silo type	Silo types			
	Concrete stave	High moisture	Bunker	Total
Surveys sent	23	4	2	39
Number returned	11	3	2	16
Percent returned	47.8%	75.0%	100.0%	41.0%

Addresses of silo manufactures were obtained through the National Silo Association headquartered in Waterloo, Iowa. Information received was separated into the three silo groups, categorized and ranked according to the structures roughage storage capacities. Average storage costs per ton for the three silo types were determined.

Results were summarized and published by Stoneberg. Since these findings are published elsewhere, those data relevant to this study are placed in the Appendix. Nonetheless, they were generated by this study and are a part of it. Appendix B includes tables showing storage losses (B-1), ownership cost percentages (B-2), silo capacities (B-3 to B-5), total investment costs (B-6) and per ton investment costs (B-7), and annual fixed costs per ton of storage for corn silage (B-8) and haylage (B-9). Annual silo costs, found in Tables B-8 and B-9, include interest, repairs, taxes and insurance. (7)

Grain storage costs were also determined. Storage capacities and investment cost were determined by contacting several grain storage firms, with the most often quoted price being used. Grain storage was limited to storing in a steel grain tank or a high moisture structure.

Using the assumptions of number of cattle fed (i.e., 100, 250, 1,000, 2,500) and the six rations shown in Table 2, it was possible to generate the total feed needs by feed ingredient. These, in turn, can be fit to certain storage structures to estimate initial investment costs and annual costs. Rations 1-4 are for 600 pounds gain while ration 5-6 are for 400 pounds gain. Given this background, Tables 8-32 were constructed. In the upper part of each table is shown the tons of required roughage storage. The particular roughage is fit to the ration type. Per ton investment cost and total investment cost are shown.

Table 8. Bunker roughage storage, 100 head

	Bunker roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	682	$25.99	$17,725	$3,368
2	341	25.99	8,863	1,684
3	227	25.99	5,900	1,121
4				
5	142	36.60	5,197	987
6	341	25.99	8,863	1,684

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$957	$1,595	$355	$2,907	$4.26	$.048	$29.07
2	479	789	177	1,454	4.26	.024	14.54
3	319	531	118	968	4.26	.016	9.68
4							
5	281	468	104	853	6.00	.019	8.53
6	479	798	177	1,454	4.26	.032	14.54

Table 9. High moisture roughage storage, 100 head

	High moisture roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	631	$ 66.60	$42,025	$7,985
2	316	97.10	30,684	5,830
3	211	97.10	20,488	3,892
4				
5	132	136.00	17,952	3,411
6	316	97.10	30,684	5,830

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$1,702	$3,782	$841	$6,325	$10.02	$.105	$63.25
2	1,243	2,762	614	4,619	14.61	.077	46.19
3	830	1,844	410	3,084	14.62	.050	30.84
4							
5	727	1,616	359	2,702	20.47	.060	27.02
6	1,243	2,762	614	4,619	14.61	.103	46.19

Table 10. Concrete stave roughage storage, 100 head

Ration	Concrete stave roughage storage			
	Tons required	Cost/ton	Investment	Salvage value
1	645	$31.06	$20,034	$3,806
2	323	42.16	13,618	2,587
3	215	47.89	10,296	1,956
4				
5	136	66.99	9,111	1,731
6	323	42.16	13,618	2,587

Ration	Annual cost						
	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$811	$1,803	$401	$3,015	$ 4.67	$.050	$30.15
2	552	1,226	272	2,050	6.35	.034	20.50
3	417	927	206	1,550	7.21	.026	15.50
4							
5	369	820	182	1,371	10.08	.030	13.71
6	552	1,226	272	2,050	6.35	.046	20.50

Table 11. Grain bin corn storage, 100 head

	Grain bin corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	2,719	$1.40	$5,207	$ 989
3	5,025	1.35	6,784	1,289
4	5,628	1.35	7,598	1,444
5	4,221	1.40	5,909	1,123
6	2,713	1.40	3,798	722

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$281	$469	$52	$ 802	$.22	$.013	$ 8.02
3	366	611	68	1,045	.21	.017	10.45
4	410	684	76	1,170	.21	.020	11.70
5	319	532	59	910	.22	.020	9.10
6	205	342	38	585	.22	.013	5.85

Table 12. High moisture corn storage, 100 head

	High moisture corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	3,895	$3.05	$11,880	$2,257
3	5,263	3.05	16,052	3,050
4	5,895	3.05	17,980	3,416
5	4,421	3.05	13,484	2,562
6	2,842	3.05	8,668	1,647

	Annaul cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$481	$1,069	$119	$1,669	$.43	$.028	$16.69
3	650	1,445	161	2,256	.43	.038	22.56
4	728	1,618	180	2,526	.43	.042	25.26
5	546	1,214	135	1,895	.43	.042	18.95
6	351	780	87	1,218	.43	.027	12.18

Table 13. Bunker roughage storage, 250 head

	Bunker roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	1,704	$20	$34,080	$6,475
2	852	21	17,892	3,399
3	568	23	13,064	2,482
4				
5	355	37	13,135	2,496
6	852	21	17,892	3,399

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$1,840	$3,067	$341	$5,248	$3.08	$.035	$20.99
2	966	1,610	179	2,755	3.23	.018	11.02
3	705	1,176	131	2,012	3.54	.013	8.05
4							
5	709	1,182	131	2,022	5.70	.018	8.09
6	966	1,610	179	2,755	3.23	.024	11.02

Table 14. High moisture roughage storage, 250 head

	High moisture roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	1,579	$ 46	$72,634	$13,801
2	789	51	40,239	7,645
3	526	67	35,242	6,696
4				
5	329	114	37,506	7,126
6	789	51	40,239	7,645

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$2,942	$6,537	$726	$10,205	$ 6.46	$.068	$40.82
2	1,630	3,622	402	5,654	7.17	.038	22.62
3	1,427	3,172	352	4,951	9.41	.033	19.80
4							
5	1,519	3,376	375	5,270	16.01	.047	21.08
6	1,630	3,622	402	5,654	7.17	.050	22.62

Table 15. Concrete stave roughage storage, 250 head

	Concrete stave roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	1,613	$25	$40,325	$7,662
2	806	29	23,374	4,441
3	538	34	18,292	3,475
4				
5	340	50	17,000	3,230
6	806	29	23,374	4,441

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$1,633	$3,629	$403	$4,665	$3.51	$.038	$22.66
2	947	2,104	234	3,285	4.08	.022	13.14
3	741	1,646	183	2,570	4.78	.017	10.28
4							
5	689	1,530	170	2,389	7.03	.021	9.56
6	947	2,104	234	3,285	4.08	.030	13.14

Table 16. High moisture corn storage, 250 head

Ration	High moisture corn storage			
	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	9,736	$2.98	$29,013	$5,513
3	13,157	2.71	35,656	6,775
4	14,736	2.72	31,978	6,076
5	11,052	2.71	29,951	5,691
6	7,105	2.98	21,173	4,023

Ration	Annual cost						
	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$1,175	$2,611	$290	$4,076	$.42	$.027	$16.30
3	1,444	3,209	357	5,010	.38	.033	20.04
4	1,295	2,878	320	4,493	.30	.030	17.97
5	1,213	2,696	300	4,209	.38	.037	16.84
6	858	1,906	212	2,976	.42	.026	11.90

Table 17. Grain bin corn storage, 250 head

	Grain bin corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	9,296	$1.35	$12,550	$2,384
3	12,562	1.20	15,074	2,864
4	14,070	1.18	16,603	3,154
5	10,552	1.20	12,662	2,406
6	6,789	1.40	9,505	1,806

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$678	$1,130	$126	$1,934	$.21	$.013	$ 7.74
3	814	1,357	151	2,322	.18	.015	9.29
4	897	1,494	166	2,2557	.18	.017	10.23
5	684	1,140	127	1,951	.18	.017	7.80
6	513	855	95	1,463	.22	.013	5.85

Table 18. Bunker roughage storage, 500 head

	Bunker roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	3,409	$18	$61,362	$11,659
2	1,705	20	34,100	6,479
3	1,136	23	26,128	4,964
4				
5	710	30	21,300	4,047
6	1,705	20	34,100	6,479

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$3,309	$5,514	$614	$9,437	$2.77	$.031	$18.87
2	1,841	3,069	341	5,251	3.08	.018	10.50
3	1,411	2,352	261	4,024	3.54	.013	8.05
4							
5	1,150	1,917	213	3,280	4.62	.015	6.56
6	1,841	3,069	341	5,251	3.08	.023	10.50

Table 19. High moisture roughage storage, 500 head

	High moisture roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	3,158	$45	$142,110	$27,000
2	1,579	46	72,634	13,800
3	1,053	48	50,544	9,603
4				
5	658	72	47,376	9,001
6	1,579	46	72,634	13,800

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$5,756	$12,790	$1,421	$19,967	$ 6.32	$.067	$39.93
2	2,948	6,537	726	10,205	6.46	.034	20.41
3	2,047	4,549	505	7,101	6.74	.024	14.20
4							
5	1,919	4,264	474	6,657	10.12	.030	13.31
6	2,942	6,537	726	10,205	6.46	.045	20.41

Table 20. Concrete stave roughage storage, 500 head

	Concrete stave roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	3,226	$22	$70,972	$13,485
2	1,613	25	40,325	7,662
3	1,075	28	30,100	5,719
4				
5	679	39	26,481	5,032
6	1,613	25	40,325	7,662

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$2,974	$6,387	$710	$9,971	$3.09	$.033	$19.94
2	1,633	3,629	403	5,665	3.51	.019	11.33
3	1.219	2,709	301	4,229	3.93	.014	8.46
4							
5	1,072	2,383	265	3,720	5.48	.017	7.44
6	1,633	3,629	403	5,665	3.51	.025	11.33

Table 21. High moisture corn storage, 500 head

Ration	High moisture corn storage			
	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	19,473	$1.89	$36,804	$ 6,993
3	26,315	1.83	48,156	9,150
4	29,473	1.83	53,936	10,248
5	22,105	1.89	41,778	7,938
6	14,210	2.42	34,388	6,534

Ration	Annual cost						
	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$1,491	$3,312	$368	$5,171	$.27	$.017	$10.34
3	1.950	4,334	482	6,766	.26	.023	13.53
4	2,185	4,854	539	7,577	.26	.025	15.15
5	1,692	3,760	418	5,870	.27	.026	11.74
6	1,393	3,095	344	4,832	.34	.043	9.66

Table 22. Grain bin corn storage, 500 head

	Grain bin corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	18,500	$1.18	$21,830	$4,148
3	25,000	1.10	27,500	5,225
4	28,000	1.13	31,640	6,012
5	21,000	1.16	24,360	4,628
6	13,500	1.18	15,930	3,027

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$1,179	$1,965	$218	$3,362	$.18	$.011	$6.72
3	1,485	2,475	275	4,235	.17	.014	8.47
4	1,709	2,848	316	4,873	.17	.016	9.75
5	1,315	2,192	243	3,750	.18	.016	7.50
6	860	1,434	159	2,453	.18	.011	4.90

Table 23. Bunker roughage storage, 1000 head

	Bunker roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	6,818	$13	$88,634	$16,840
2	3,409	18	61,362	11,659
3	2,273	22	50,006	9,501
4				
5	1,420	28	39,760	7,554
6	3,409	18	61,362	11,659

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$4,786	$7,977	$886	$13,649	$2.00	$.023	$13.65
2	3,314	5,523	614	9,451	2.77	.016	9.45
3	2,700	4,501	500	7,701	3.39	.013	7.70
4							
5	2,147	3,578	398	6,123	4.31	.014	6.12
6	3,314	5,523	614	9,451	2.77	.021	9.45

Table 24. High moisture roughage storage, 1000 head

	High moisture roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	6,316	$44	$277,904	$52,802
2	3,158	45	142,110	27,010
3	2,105	46	96,830	18,398
4				
5	1,315	65	85,475	16,240
6	3,158	45	142,110	27,010

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$11,255	$25,011	$2,779	$39,045	$6.18	$.065	$39.05
2	5,755	12,790	1,421	19,966	6.32	.033	19.97
3	3,922	8,715	968	13,605	6.46	.023	13.61
4							
5	3,462	7,693	855	12,010	9.13	.027	12.01
6	5,755	12,790	1,421	19,966	6.32	.044	19.97

Table 25. Concrete stave roughage storage, 1000 head

	Concrete stave roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	6,452	$21	$135,492	$25,743
2	3,226	22	70,972	13,485
3	2,151	24	51,624	9,807
4				
5	1,358	35	47,530	9.031
6	3,226	22	70,972	13,485

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$5,487	$12,194	$1,354	$19,035	$2.95	$.032	$19.04
2	2,874	6,387	710	9,971	3.09	.017	9.97
3	2,091	4,646	516	7,253	3.37	.012	7.25
4							
5	1,925	4,278	475	6,678	4.91	.015	6.68
6	2,874	6,387	710	9,971	3.09	.022	9.98

Table 26. High moisture corn storage, 1000 head

	High moisture corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	37,000	$1.80	$66,600	$12,654
3	50,000	1.75	87,500	16,625
4	56,000	1.75	98,000	18,620
5	42,000	1.80	75,600	14,364
6	27,000	1.83	49,410	9,388

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$2,697	$5,994	$666	$ 9,357	$.25	$.016	$ 9.36
3	3,544	7,875	875	12,294	.25	.020	12.29
4	3,969	8,820	980	13,769	.25	.023	13.77
5	3,062	6,804	756	10,622	.25	.024	10.62
6	2,001	4,447	494	6,942	.26	.015	6.94

Table 27. Grain bin corn storage, 1000 head

	Grain bin corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	37,000	$ .90	$33,300	$6,327
3	50,000	.86	43,000	8,170
4	56,000	.86	48,160	9,150
5	42,000	.90	37,800	7,182
6	27,000	1.10	29,700	5,643

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$1,798	$2,997	$333	$5,128	$.14	$.009	$5.12
3	2,322	3,870	430	6,622	.13	.011	6.62
4	2,601	4,334	482	7,417	.13	.012	7.41
5	2,041	3,402	378	5,821	.14	.013	5.82
6	1,604	2,673	297	4,574	.17	.010	4.57

Table 28. Bunker roughage storage, 2500 head

	Bunker roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	17,045	$12	$204,540	$38,863
2	8,523	12	102,276	19,432
3	5,682	13	73,866	14,035
4				
5	3,551	22	78,122	14,843
6	8,523	12	102,276	19,432

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$11,045	$18,409	$2,045	$31,499	$1.81	$.021	$12.60
2	5,523	9,205	1,023	15,751	1.85	.011	6.30
3	3,989	6,648	739	11,376	2.00	.008	4.55
4							
5	4,218	7,031	781	12,030	3.39	.011	4.81
6	5,523	9,205	1,023	15,751	1.85	.014	6.30

Table 29. High moisture roughage storage 2500 head

	High moisture roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	15,789	$44	$694,716	$131,996
2	7,895	44	347,380	66,002
3	5,263	44	231,572	43,999
4				
5	3,289	64	210,496	39,994
6	7,895	44	347,380	66,002

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$28,136	$62,524	$6,947	$97,607	$6.18	$.065	$39.04
2	14,069	31,264	3,474	48,807	6.18	.033	19.52
3	9,379	20,841	2,316	32,536	6.18	.022	13.01
4							
5	8,525	18,945	2,105	29,575	8.99	.026	11.83
6	14,069	31,264	3,474	48,807	6.18	.043	19.52

Table 30. Concrete stave roughage storage, 2500 head

	Concrete stave roughage storage			
Ration	Tons required	Cost/ton	Investment	Salvage value
1	16,130	$21	$338,730	$64,359
2	8,065	21	169,365	32,179
3	5,376	21	112,896	21,450
4				
5	3,397	31	105,307	20,008
6	8,065	21	169,365	32,179

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per ton	Annual cost /lb. gain	Annual cost per head
1	$13,719	$30,486	$3,387	$47,592	$2.95	$.032	$19.04
2	6,859	15,243	1,694	23,796	2.95	.016	9.52
3	4,572	10,161	1,129	15,862	2.95	.011	6.34
4							
5	4,265	9,478	1,053	14,796	4.35	.013	5.92
6	6,859	15,243	1,694	23,746	2.95	.021	9.52

Table 31. High moisture corn storage, 2500 head

	High moisture corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	92,500	$1.73	$160,025	$30,405
3	125,000	1.73	216,250	41,088
4	140,000	1.70	238,000	45,220
5	105,000	1.73	181,650	34,514
6	67,500	1.75	118,125	22,444

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$6,481	$14,402	$1,600	$22,483	$.24	$.015	$ 8.99
3	8,758	19,463	2,163	30,384	.24	.020	12.15
4	9,639	21,420	2,380	33,439	.24	.022	13.38
5	7,357	16,349	1,817	25,523	.24	.023	10.21
6	4,784	10,631	1,181	16,596	.25	.015	6.64

Table 32. Grain bin corn storage, 2500 head

	Grain bin corn storage			
Ration	Bushels required	Cost/bushel	Investment	Salvage value
1				
2	92,500	$.81	$ 74,925	$14,236
3	125,000	.78	97,500	18,525
4	140,000	.76	106,400	20,216
5	105,000	.80	84,000	15,960
6	67,500	.84	56,700	10,773

	Annual cost						
Ration	Depreciation	Interest	Repairs & insurance	Total annual cost	Annual cost per bushel	Annual cost /lb. gain	Annual cost per head
1							
2	$4,046	$6,743	$ 749	$11,538	$.12	$.008	$4.62
3	5,265	8,775	975	15,015	.12	.010	6.00
4	5,746	9,576	1,064	16,386	.12	.011	6.55
5	4,536	7,560	840	12,936	.12	.009	5.17
6	3,062	5,103	567	8,732	.13	.006	3.49

The lower portion of each table shows the annual costs by type of cost and per unit of measure. Units of measure include per ton of ingredients, per pounds of gain and per head. Tables 8-12 cover the 100 head size, Tables 13-17 the 250 head size, Tables 18-22 the 500 head size, Tables 23-27 the 1000 head size, and Tables 28-32 the 2500 head size. Roughage storage is separated from grain storage and appear in different tables. Depreciation was limited to the straight line method of calculation (4). Salvage values were calculated as 19 percent of the basis value. Years of life were 20 years for both the concrete stave and high moisture structures and 15 years for the bunker silos. Repairs and insurance were determined through a percentage of the original cost per year. Annual cost per ton was based on storage capacities of the structures.

There are economies of scale involved with the construction of both roughage and grain storage facilities. As storage capacities increase, cost per bushel per ton decrease. Therefore, the larger quantities stored resulted in less cost per bushel or ton.

Generally, bunker silos result in the least cost per ton of roughage stored, followed by concrete stave structures. Gas tight storage structures resulted in the greatest cost per ton stored. It was assumed that the structures were filled only once per year.

There are several factors which may cause a farmer to select one of the storage systems. Storage flexibility, combining feedstuffs with the ration, storage losses, quality of feed output, convenience and feed distribution systems, are examples.

CHAPTER IV: FEED DISTRIBUTION SYSTEMS

Feed distribution systems were designed with the aid of the telephone survey, and Spencer area trip. Feed distribution systems used in this study were the most often quoted systems found within the telephone survey.

Investment cost for equipment for the feed distribution systems were realistic values quoted from several retail machinery dealerships in central Iowa. Items included in annual ownership costs included depreciation, interest, repairs and insurance. Depreciation was calculated by the straight line method. All equipment was assumed to be purchased new with no trade in. Years of life and salvage values were estimated for each equipment type. Years of life ranged from five to 20 years. Salvage values were calculated using 19 percent of the basis value. Interest reflects an after tax value of nine percent. Repairs and insurance were determined through a percentage of the original cost per year, with various rates used for the different equipment types.

Equipment for the distribution systems included all major items to properly distribute the feedstuffs to the cattle.

System Description

Feed distribution systems studied included portable grinder mixers, auger wagons, and fully automated systems. Where applicable, these systems are included with the several grain and roughage storage facilities specified by the feeding program.

Portable grinder mixers

Farmers using a portable grinder mixer system combine two steps in one machine. First, the feed ingredients are loaded into the machine, ground and blended together. Second, the feed is distributed to the cattle, while remaining in the grinder mixer, through an auger on the machine. Thus, the farmer grinds, mixes, and distributes the feed with the same machine.

The telephone survey indicated 13.6 percent of the farms ground and mixed the feedstuffs within the grinder mixer, while fifteen percent were found to distribute the feed to their cattle with the portable grinder mixer. The latter, therefore, probably utilized a stationary grinding and blending system to prepair the feedstuffs for the cattle.

A disadvantage of a grinder mixer system is its relatively limited volume of output, which makes feeding large groups of cattle difficult. The machine itself is limited in size by the fact that it is portable and must both process and distribute the feedstuffs to the cattle.

An advantage to the system, however, is the fact that the feed is both processed and distributed by the same machine. For smaller feedlots this is an advantage as the need for purchasing a stationary mill is eliminated. Time is also saved as the ration may be placed directly into the grinder mixer for processing and transportation to the cattle. This eliminates feed handling when compared to a stationary mill where the feedstuffs must first be placed in the mill, processed, removed from the mill and placed into the machine used to distributed the feed.

Facilities and equipment used in this system include: roughage, grain, and concentrate storage facilities; grinder mixer; and tractor.

Auger wagon

This system again utilizes a single machine for a two step process. It, like the portable grinder mixer, blends the feed ingredients together and will auger the ration into the feedbunks. It does not grind the feed ingredients, however. The feed is ground elsewhere, usually by a stationary mill or cracker. Normally, it has a larger hauling capacity and its original investment is less than a grinder mixer.

This system is time efficient in its operation, often being used in large cattle feeding operations. The larger feedlots place an auger wagon directly on a truck chassis which decreases the time needed to transport the feed from the place of processing to the feed bunks, and the return to the feed plant.

The telephone survey indicated 63.8 percent of the farmers used an auger wagon to transport the feed to the feedbunks. Forty-six and one-half sample said they blended the feed ingredients with the auger wagon. It could be assumed that the percentage difference between the two values, 17.3 percent, indicates that amount of the sample used rations which needed processing or cracking, and was done at a mill.

Equipment needed for this system includes: roughage, grain, and concentrate storage facilities; auger wagon; tractor; and possibly a mill if the ration calls for ground feedstuffs.

Automated systems

Automated feeding systems are usually popular among cattle feeders who are short on labor, as this system does not tie up the farmer's labor time doing chores. Farmers interviewed indicated once the ration was formalized on the time clock, the only labor spent with the cattle during feeding was to insure the machinery was operating correctly.

A plus for the system is the machinery's ability to cope with weather and feedlot conditions. Feedlots are notorious for collecting snow, water, and mud. These elements often hinder the distribution of feedstuffs with non-automated systems. Automated systems are not fool-proof, however, as they may become plugged by the elements also. Electrical failures also create problems for this system as conveyors are normally run by electricity.

The original cost of the system is expensive. Of the systems studied, the automated system had the highest startup cost.

This system also occupies much space, especially if a large number of cattle are fed by it. Feedlot space needed per head of cattle is relatively constant. Therefore, the larger the number of cattle on feed, the greater the length of automated feeder space needed. There are not many economies of scale with automated systems as the major cost items are constant per unit added.

The telephone survey indicated 28 percent of the sample used automated feed distribution systems on their farms.

Equipment needed in this system includes: roughage, grain, and supplement storage structures; a forage meter to properly blend the

roughage and concentrates; and an auger or conveyor system to distribute feedstuffs to the cattle.

In all systems, the options of buying all of the feedstuffs at a feed store or elevator is ruled out. This would have eliminated the need for storage structures on the farm. The grinder mixer and auger wagon system used precast concrete fenceline bunks, while the automated system used in-lot bunks so the cattle could eat from both sides of the feed bunk.

Tables 33 through 49 show the investment, total annual cost, annual cost per head, and the annual cost per pound of gain for the five levels of feeding cattle and the feed distribution systems studied. Tables 50-54 show the costs for feed storage systems and Tables 55-59 summarize the feed distribution systems cost for each level of cattle feeding.

Determining Least Cost Distribution Systems

The following steps need to be followed to determine the cost of the feed distribution system:

1. select the number of cattle to be fed per year, either 100, 250, 500, 1000, or 2500 head;
2. select the ration to be fed from Table 2;
3. find the total weight gain associated with the total number head fed per year from Table 60;
4. select among the three alternatives for storing the roughages if silage is part of the ration from Tables 50 through 54, and record its cost;

Table 33. One hundred head cattle, silo to unloader wagon feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	1,550	300	10	.09	.5
Tractor	1,600	300	6	.09	1.0
Feeding apron	592		12	.09	.5
Unloader wagon	4,800	700	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Total	9,192				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	125	140	7	272
Tractor	217	144	16	377
Feeding apron	49	53	3	105
Unloader wagon	683	432	72	1,187
Supplement bin and pad	60	59	7	131

Total annual cost	$2,072
Per head	20.72
Per pound gain ration 1-4	.035
Per pound gain ration 5-6	.046

Table 34. One hundred head cattle, bunker to unloader wagon

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	1,550	300	10	.09	.5
Tractor	3,200	600	6	.09	1.0
Feeding apron	592		12	.09	.5
Unloader wagon	4,800	700	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Loader	420	60	6	.09	.5
Total	11,212				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	125	140	7	272
Tractor	433	288	32	753
Feeding apron	49	53	3	105
Unloader wagon	683	432	72	1,187
Supplement bin and pad	60	59	7	131
Loader	60	38	2	100

Total annual cost	$2,548
Per head	25.48
Per pound gain ration 1-4	.042
Per pound gain ration 5-6	.057

Table 35. One hundred head cattle, grinder mixer

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	1,550	300	10	.09	.5
Tractor	3,200	600	6	.09	1.0
Feeding apron	592		12	.09	.5
Supplement bin and pad	650	50	10	.09	1.0
Grinder mixer	5,650	900	6	.09	1.5
Total	11,642				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	125	140	7	272
Tractor	433	288	32	753
Feeding apron	49	53	3	105
Supplement bin and pad	60	59	7	131
Grinder mixer	792	509	85	1,386

Total annual cost	$2,647
Per head	26.47
Per pound gain ration 1-4	.044
Per pound gain ration 5-6	.059

Table 36. One hundred head cattle, automatic feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feeding pad	560		10	.09	.5
Automatic feeding conveyor	4,095	778	7	.09	2.0
Roof	500	95	10	.09	.5
Auger	360	68	7	.09	1.0
Forage meter	7,500	1,425	7	.09	1.0
Supplement bin and pad	650	50	10	.09	1.0
Total	13,665				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feeding pad	56	50	3	109
Automatic conveyor	474	369	82	925
Roof	41	45	3	89
Auger	42	32	4	78
Forage meter	975	675	75	1,725
Supplement bin and pad	60	59	6	125

Total annual cost	$3,051
Per head	30.51
Per pound gain ration 1-4	.051
Per pound gain ration 5-6	.069

Table 37. Two hundred fifty head cattle, silo to unloader wagon feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	3,875	730	10	.09	.5
Tractor	2,800	530	6	.09	1.0
Feeding apron	2,962		12	.09	.5
Unloader wagon	4,800	700	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Total	15,087				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	312	349	19	680
Tractor	378	252	28	658
Feeding apron	247	267	15	529
Unloader wagon	683	432	72	1,187
Supplement bin and pad	60	59	6	125

Total annual cost	$3,179
Per head	12.72
Per pound gain ration 1-4	.021
Per pound gain ration 5-6	.028

Table 38. Two hundred fifty head cattle, bunker to unloader wagon

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	3,875	755	10	.09	.5
Tractor	4,800	900	6	.09	1.5
Feeding apron	2,962		12	.09	.5
Unloader wagon	4,800	700	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Loader	840	120	6	.09	.5
Total	17,927				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	312	349	19	680
Tractor	650	432	72	1,154
Feeding apron	247	267	15	529
Unloader wagon	683	432	72	1,187
Supplement bin and pad	60	59	6	125
Loader	120	76	4	200

Total annual cost	$3,875
Per head	15.50
Per pound gain ration 1-4	.026
Per pound gain ration 5-6	.034

Table 39. Two hundred fifty head cattle, grinder mixer

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	3,875	755	10	.09	.5
Tractor	4,800	900	6	.09	1.5
Feed apron	2,962		12	.09	.5
Supplement bin and pad	650	50	10	.09	1.0
Grinder mixer	7,170	1,300	5	.09	2.0
Total	19,457				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	312	349	19	680
Tractor	650	432	72	1,154
Feed apron	247	267	15	529
Supplement bin and pad	60	59	6	125
Grinder mixer	1,174	645	143	1,962

Total annual cost	$4,450
Per head	17.80
Per pound gain ration 1-4	.030
Per pound gain ration 5-6	.040

Table 40. Two hundred fifty head cattle, automatic feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feeding pad	1,386		10	.09	.5
Automatic feeding conveyor	10,140	1,927	7	.09	2.0
Roof	1,248	237	10	.09	.5
Auger	360	68	7	.09	1.0
Forage meter	7,500	675	7	.09	1.0
Supplement bin and pad	650	50	10	.09	1.0
Total	21,284				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feeding pad	139	125	7	271
Automatic feeding conveyor	1,173	913	203	2,289
Roof	101	112	6	219
Auger	42	32	4	78
Forage meter	975	675	75	1,725
Supplement bin and pad	60	59	6	125

Total annual cost	$4,707
Per head	18.82
Per pound gain ration 1-4	.031
Per pound gain ration 5-6	.042

Table 41. Five hundred head cattle, silo to unloader wagon feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	7,750	1,475	10	.09	.5
Tractor	12,000	2,280	6	.09	1.5
Feeding apron	2,960		12	.09	.5
Unloader wagon	5,900	1,100	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Total	29,260				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	628	698	39	1,365
Tractor	1,620	1,080	180	2,880
Feeding apron	247	266	15	528
Unloader wagon	800	531	89	1,420
Supplement bin and pad	60	59	7	131

Total annual cost	$6,324
Per head	12.65
Per pound gain ration 1-4	.021
Per pound gain ration 5-6	.028

Table 42. Five hundred head cattle, bunker to unloader wagon

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	7,750	1,475	10	.09	.5
Tractor	12,000	2,280	6	.09	1.5
Feeding apron	2,960		12	.09	.5
Unloader wagon	5,900	1,100	6	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Loader	2,400	450	6	.09	1.0
Total	31,660				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	628	628	39	1,365
Tractor	1,620	1,080	180	2,880
Feeding apron	247	266	15	528
Unloader wagon	800	531	89	1,420
Supplement bin and pad	60	59	7	131
Loader	325	216	24	565

Total annual cost	$6,889
Per head	13.78
Per pound gain ration 1-4	.023
Per pound gain ration 5-6	.031

Table 43. Five hundred head cattle, automatic feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feeding pad	2,772		10	.09	.5
Automatic feeding conveyor	20,280	3,853	7	.09	2.0
Roof	2,496	474	10	.09	.5
Auger	720	137	7	.09	1.0
Forage meter	15,000	2,850	7	.09	1.5
Supplement bin and pad	650	50	10	.09	1.0
Total	42,568				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feeding pad	277	249	14	540
Automatic feeding conveyor	2,347	1,825	405	4,577
Roof	202	225	13	440
Auger	83	65	7	155
Forage meter	1,736	1,350	225	3,311
Supplement bin and pad	60	59	7	131

Total annual cost	$9,154
Per head	18.31
Per pound gain ration 1-4	.031
Per pound gain ration 5-6	.041

Table 44. One thousand head cattle, silo to unloader wagon feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	15,500	2,945	10	.09	.5
Feeding apron	5,920		12	.09	.5
Truck with unloader wagon	24,900	4,731	6	.09	1.5
Supplement bin and pad	1,400	100	10	.09	1.0
Total	47,720				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	1,256	1,395	78	2,729
Feeding apron	493	533	30	1,056
Truck with unloader wagon	3,362	2,241	374	5,977
Supplement bin and pad	130	126	14	270

Total annual cost	$10,032
Per head	10.03
Per pound gain ration 1-4	.017
Per pound gain ration 5-6	.023

Table 45. One thousand head cattle, bunker to unloader wagon

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	15,500	2,945	10	.09	.5
Payloader	24,000	4,560	6	.09	1.5
Feeding apron	5,920		12	.09	.5
Truck with unloader wagon	24,900	4,731	6	.09	1.5
Supplement bin and pad	1,400	100	10	.09	1.0
Total	71,720				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	1,256	1,395	78	2,729
Payloader	3,240	2,160	360	5,760
Feeding apron	493	533	30	1,056
Truck with unloader wagon	3,362	2,241	374	5,977
Supplement bin and pad	130	126	14	270

Total annual cost	$15,792
Per head	15.79
Per pound gain ration 1-4	.027
Per pound gain ration 5-6	.035

Table 46. One thousand head cattle, automatic feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feeding pads	5,545		10	.09	.5
Automatic feeding conveyor	40,560	7,687	7	.09	2.0
Roof	4,992	948	10	.09	.5
Auger	1,440	274	7	.09	1.0
Forage meter	30,000	5,700	7	.09	1.5
Supplement bin and pad	1,400	100	7	.09	1.0
Total	83,937				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Pad	554	499	28	1,081
Automatic auger	4,696	3,650	811	9,157
Roof	404	449	25	878
Auger	167	130	14	311
Forage meter	3,471	2,700	450	6,621
Supplement bin and pad	130	126	14	270

Total annual cost	$18,318
Per head	18.32
Per pound gain ration 1-4	.031
Per pound gain ration 5-6	.041

Table 47. Two thousand five hundred head cattle, silo to unloader wagon feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	38,750	7,363	10	.09	.5
Truck with unloader wagon	37,500	7,125	6	.09	1.5
Feeding apron	14,800		12	.09	.5
Supplement bin and pad	3,300	300	10	.09	1.0
Total	94,350				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	3,139	3,488	194	6,821
Truck with unloader wagon	5,062	3,375	563	9,000
Feeding apron	1,233	1,332	740	3,305
Supplement bin and pad	300	330	33	663

Total annual cost	$19,789
Per head	7.92
Per pound gain ration 1-4	.013
Per pound gain ration 5-6	.018

Table 48. Two thousand five hundred head cattle, bunker to unloader wagon

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feed bunks	38,750	7,363	10	.09	.5
Payloader	24,000	4,560	6	.09	1.5
Feeding apron	14,800		12	.09	.5
Truck with unloader wagon	37,500	7,125	6	.09	1.5
Supplement bin and pad	3,300	300	10	.09	1.0
Total	118,350				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Feed bunks	3,139	3,488	194	6,821
Payloader	3,240	2,160	360	5,760
Feeding apron	1,233	1,332	74	3,369
Truck with unloader wagon	5,062	3,375	563	9,000
Supplement bin and pad	300	330	33	663

Total annual cost	$24,883
Per head	9.95
Per pound gain ration 1-4	.017
Per pound gain ration 5-6	.022

Table 49. Two thousand five hundred head cattle, automatic feed distribution system

Item	Investment ($)	Salvage value ($)	Depreciation life	Interest %	Repairs and insurance %
Feeding pad	13,864		10	.09	.5
Automatic feeding conveyor	101,400	19,000	7	.09	2.0
Roof	12,480	2,300	10	.09	.5
Auger	3,600	350	7	.09	1.0
Forage meter	75,000	14,000	7	.09	1.5
Supplement bin and pad	3,300	300	10	.09	1.0
Total	209,644				

	Annual cost			
Item	Depreciation ($)	Interest ($)	Repairs and insurance ($)	Annual cost ($)
Pad	1,386	1,248	69	2,703
Auger assembly	11,771	9,126	2,028	22,925
Roof	1,018	1,123	62	2,203
Auger	464	324	36	824
Forage meter	8,174	6,750	1,125	16,589
Supplement bin and pad	300	330	33	663

Total annual cost	$45,907
Per head	18.36
Per pound gain ration 1-4	.031
Per pound gain ration 5-6	.041

Table 50. Costs data for feed storage systems and rations (100 cattle)

	Investment	Annual cost	Cost/ head	Cost/ lb. gain	Ration cost[a]	Ration cost/ head	Ration cost/ lb. gain	Total cost /pound gained
Roughage storage								
Concrete stave								
Ration 1	$20,034	$3,015	$30.15	$.050	$10,320	$103.20	$.172	$.222
2	13,618	2,050	20.50	.034	5,168	51.68	.086	.120
3	10,296	1,550	15.50	.026	3,440	34.40	.057	.083
4								
5	9,111	1,371	13.71	.030	3,400	34.00	.076	.106
6	13,618	2.050	20.50	.046	5,168	51.68	.114	.160
High moisture								
Ration 1	42,025	6,325	63.25	.105	10,096	100.96	.168	.273
2	30,684	4,619	46.19	.077	5,056	50.56	.084	.161
3	20,488	3,084	30.84	.051	3,376	33.76	.056	.107
4								
5	17,952	2,702	27.02	.060	3,300	33.00	.073	.133
6	30,684	4,619	46.19	.103	5,056	50.56	.112	.215
Bunker								
Ration 1	3,368	2,907	29.07	.048	10,912	109.12	.181	.229
2	1,684	1,454	14.54	.024	5,456	54.56	.090	.114
3	1,121	968	9.68	.016	3,632	36.32	.060	.076
4								
5	987	853	8.53	.019	3,550	35.50	.079	.098
6	1,684	1,454	14.54	.032	5,456	54.56	.121	.153

Grain storage								
Bin								
Ration 1								
2	5,207	902	8.02	.013	9,112	91.12	.152	.165
3	6,784	1,045	10.45	.017	12,311	123.11	.205	.222
4	7,598	1,170	11.70	.020	13,788	137.88	.229	.249
5	5,909	910	9.10	.020	10,341	103.41	.229	.249
6	3,798	585	5.85	.013	6,646	66.46	.148	.161
High moisture								
Ration 1								
2	11,880	1,669	16.69	.028	9,543	95.43	.159	.187
3	16,052	2,256	22.56	.038	12,894	128.94	.214	.252
4	17,980	2,526	25.26	.042	14,442	144.42	.240	.282
5	13,484	1,895	18.95	.042	10,831	108.31	.240	.282
6	8,668	1,218	12.18	.027	6,962	69.62	.154	.181
Supplement								
Ration 1					3,900	39.00	.065	.065
2					3,393	33.93	.056	.056
3					3,120	31.20	.052	.052
4					3,393	33.93	.056	.056
5					2,340	23.40	.052	.052
6					2,340	23.40	.052	.052
Hay								
Ration 4					3,800	38.00	.063	.063

[a]In this and all subsequent tables, see Table 61 for ration ingredient cost.

Table 51. Cost data for feed storage systems and rations (250 cattle)

	Investment	Annual cost	Cost/ head	Cost/ lb. gain	Ration cost	Ration cost/ head	Ration cost/ lb. gain	Total cost /pound gained
Roughage storage								
Concrete stave								
Ration 1	$40,325	$ 5,665	$22.66	$.038	$25,808	$103.20	$.172	$.210
2	23,374	3,285	13.14	.022	12,896	51.68	.086	.108
3	18,292	2,570	10.28	.017	8,608	34.40	.057	.074
4								
5	17,000	2,389	9.56	.021	8,500	34.00	.076	.097
6	23,374	3,285	13.14	.030	12,896	51.68	.114	.144
High moisture								
Ration 1	72,634	10,205	40.82	.068	25,264	100.96	.168	.236
2	40,239	5,654	22.62	.038	12,624	50.56	.084	.122
3	35,242	4,951	19.80	.033	8,416	33.76	.056	.089
4								
5	37,500	5,270	21.08	.047	8,225	33.00	.073	.120
6	40,239	5,654	22.62	.050	12,624	50.56	.112	.162
Bunker								
Ration 1	34,080	5,248	20.99	.035	27,264	109.12	.181	.216
2	17,892	2,755	11.02	.018	13,632	54.56	.090	.108
3	13,064	2,012	8.05	.013	9,088	36.32	.060	.073
4								
5	13,135	2,022	8.09	.018	8,875	35.50	.079	.097
6	17,892	2,755	11.02	.024	13,632	54.56	.121	.145

Grain storage								
Bin								
Ration 1								
2	12,550	1.934	7.74	.013	22,775	91.12	.152	.165
3	15,074	2,322	9.29	.015	30,776	123.11	.205	.220
4	16,603	2,557	10.23	.017	34,471	137.88	.229	.246
5	12,662	1,951	7.80	.017	25,852	103.41	.229	.246
6	9,505	1,463	5.85	.013	16,633	66.46	.148	.161
High moisture								
Ration 1								
2	29,013	4,076	16.30	.027	23,853	95.43	.159	.186
3	35,656	5,010	20.04	.033	32,234	128.94	.214	.247
4	31,978	4,493	17.97	.030	14,442	144.42	.240	.270
5	29,951	4,209	16.84	.037	27,077	108.31	.240	.277
6	21,173	2,976	11.90	.026	17,407	69.62	.154	.180
Supplement								
Ration 1					9,750	39.00	.065	.065
2					8,482	33.93	.056	.056
3					7,800	31.20	.052	.052
4					3,393	33.93	.056	.056
5					5,850	23.40	.052	.052
6					5,850	23.40	.052	.052
Hay								
Ration 4					3,800	38.00	.063	.063

Table 52. Costs data for feed storage systems and rations (500 cattle)

	Investment	Annual cost	Cost/ head	Cost/ lb. gain	Ration cost	Ration cost/ head	Ration cost/ lb. gain	Total cost /pound gained
Roughage storage								
Concrete stave								
Ration 1	$70,972	$ 9,971	$19.94	$.033	$51,616	$103.20	$.172	$.205
2	40,325	5,665	11.33	.019	25,808	51.68	.086	.105
3	30,100	4,229	8.46	.014	17,200	34.40	.057	.071
4								
5	26,481	3,720	7.44	.017	16,975	34.00	.076	.093
6	40,325	5,665	11.33	.025	25,808	51.68	.114	.139
High moisture								
Ration 1	142,110	19,967	39.93	.067	50,528	100.96	.168	.235
2	72,634	10,305	20.41	.034	25,264	50.56	.084	.118
3	50,544	7,101	14.20	.024	16,848	33.76	.056	.080
4								
5	47,376	6,657	13.31	.030	16,450	33.00	.073	.103
6	72,634	10,205	20.41	.045	25,264	50.56	.112	.157
Bunker								
Ration 1	61,362	9,437	18.87	.031	54,544	109.12	.181	.212
2	34,100	5,251	10.50	.018	27,280	54.56	.090	.108
3	26,128	4,024	8.05	.013	18,176	36.22	.060	.073
4								
5	21,300	3,280	6.56	.015	17,750	35.50	.079	.094
6	34,100	5,251	10.50	.023	27,280	54.56	.121	.144

Grain storage								
Bin								
Ration 1								
2	21,830	3,362	6.72	.011	45,550	91.12	.152	.163
3	27,500	4,235	8.47	.014	61,556	123.11	.205	.245
4	31,640	4,873	9.76	.016	68,943	137.88	.229	.245
5	24,360	3,750	7.50	.016	51,707	103.41	.229	.245
6	15,930	2,453	4.90	.011	33,239	66.46	.148	.159
High moisture								
Ration 1								
2	36,804	5,171	10.34	.017	47,708	95.43	.159	.176
3	48,156	6,766	13.53	.023	64,471	128.94	.214	.237
4	53,936	7,577	15.15	.025	72,208	144.42	.240	.265
5	41,778	5,870	11.74	.026	54,157	108.31	.240	.266
6	34,388	4,832	9.66	.043	34,814	69.62	.154	.197
Supplement								
Ration 1					19,500	39.00	.065	.065
2					16,965	33.93	.056	.056
3					15,600	31.20	.052	.052
4					16,965	33.93	.056	.056
5					11,700	23.40	.052	.052
6					11,700	23.40	.052	.052
Hay								
Ration 4					19,050	38.00	.063	.063

Table 53. Costs data for feed storage systems and rations (1000 cattle)

	Investment	Annual cost	Cost/ head	Cost/ lb. gain	Ration cost	Ration cost/ head	Ration cost/ lb. gain	Total cost /pound gained
Roughage storage								
Concrete stave								
Ration 1	$135,492	$19,035	$19.04	$.032	$103,232	$103.20	$.172	$.204
2	70,972	9,971	9.97	.017	51,616	51.68	.086	.103
3	51,624	7,253	7.25	.012	34,416	34.40	.057	.069
4								
5	47,530	6,678	6.68	.015	33,950	34.00	.076	.091
6	70,972	9,971	9.98	.022	51,616	51.68	.114	.136
High moisture								
Ration 1	277,904	39,045	39.05	.065	101,056	100.96	.168	.233
2	142,110	19,966	19.97	.033	50,528	30.56	.084	.117
3	96,830	13,605	13.61	.023	33,680	33.76	.056	.079
4								
5	85,475	12,010	12.01	.027	32,875	33.00	.073	.100
6	142,110	19,966	19.97	.044	50,528	50.56	.112	.156
Bunker								
Ration 1	88,634	13,649	13.65	.023	109,088	109.12	.181	.204
2	61,362	9,451	9.45	.016	54,544	54.56	.090	.106
3	50,006	7,701	7.70	.013	36,368	36.32	.060	.073
4								
5	39,760	6,123	6.12	.014	35,500	35.50	.079	.093
6	61,362	9,451	9.45	.021	54,544	54.56	.121	.142

Grain storage								
Bin								
Ration 1								
2	33,300	5,128	5.12	.009	91,120	91.12	.152	.161
3	43,000	6,622	6.62	.011	123,114	123.11	.205	.216
4	48,160	7,417	7.14	.012	137,888	137.88	.229	.241
5	37,800	5,821	5.82	.013	103,416	103.41	.148	.242
6	29,700	4,571	4.57	.010	66,460	66.46	.148	.158
High moisture								
Ration 1								
2	66,600	9,357	9.36	.016	95,420	95.43	.159	.175
3	87,500	12,294	12.29	.020	128,945	128.94	.214	.234
4	98,000	13,769	13.77	.023	144,420	144.42	.240	.263
5	75,600	10,622	10.62	.023	108,314	108.31	.240	.263
6	49,410	6,942	6.94	.015	69,631	69.62	.154	.169
Supplement								
Ration 1					39,000	39.00	.065	.065
2					33,930	33.93	.056	.056
3					31,200	31.20	.052	.052
4					33,930	33.93	.056	.056
5					23,400	23.40	.052	.052
6					23,400	23.40	.052	.052
Hay								
Ration 4					38,150	38.00	.063	.063

Table 54. Costs data for feed storage systems and rations (2500 cattle)

	Investment	Annual cost	Cost/ head	Cost/ lb. gain	Ration cost	Ration cost/ head	Ration cost/ lb. gain	Total cost /pound gained
Roughage storage								
Concrete stave								
Ration 1	$338,730	$47,592	$19.04	$.032	$258,080	$103.20	$.172	$.204
2	169,365	23,796	9.52	.016	129,040	51.68	.086	.102
3	112,896	15,862	6.34	.011	86,016	34.40	.057	.068
4								
5	105,307	14,796	5.92	.013	84,975	34.00	.076	.089
6	169,365	23,746	9.52	.021	129,040	51.68	.114	.135
High moisture								
Ration 1	694,716	97,607	39.04	.065	252,624	100.96	.168	.233
2	347,380	48,807	19.52	.033	126,320	50.56	.084	.117
3	231,572	32,536	13.01	.022	84,208	33.76	.056	.078
4								
5	210,496	29,575	11.83	.026	82,225	33.00	.073	.099
6	347,380	48,807	19.52	.043	126,320	50.56	.112	.155
Bunker								
Ration 1	204,540	31,499	12.60	.021	272,720	109.12	.181	.202
2	102,276	15,751	6.30	.011	136,368	54.56	.090	.101
3	73,866	11,376	4.55	.008	90,912	36.32	.060	.068
4								
5	78,122	12,030	4.81	.001	88,775	35.50	.079	.080
6	102,276	15,751	6.30	.014	136,368	54.56	.121	.135

Grain storage								
Bin								
Ration 1								
2	74,925	11,538	4.62	.008	227,761	91.12	.152	.160
3	97,500	15,016	6.00	.010	307,788	123.11	.205	.215
4	106,400	16,386	6.55	.011	344,722	137.88	.229	.240
5	84,000	12,936	5.17	.009	258,541	103.41	.229	.238
6	56,700	8,732	3.49	.006	166,205	66.46	.148	.154
High moisture								
Ration 1								
2	160,025	22,483	8.99	.015	238,551	95.43	.159	.174
3	216,250	30,384	12.15	.020	322,361	128.94	.214	.234
4	238,000	33,439	13.38	.022	361,051	144.42	.240	.262
5	181,650	25,523	10.21	.023	270,788	108.31	.240	.263
6	118,125	16,596	6.64	.015	174,077	69.62	.154	.169
Supplement								
Ration 1					97,500	39.00	.065	.065
2					84,825	33.93	.056	.056
3					78,000	31.20	.052	.052
4					84,825	33.93	.056	.056
5					58,500	23.40	.052	.052
6					58,500	23.40	.052	.052
Hay								
Ration 4					94,450	38.00	.063	.063

Table 55. Feed distribution system cost for 100 head of cattle[a]

System type	Investment	Annual cost	Cost/ head	Cost/lb. of gain	
				Ration 1-4	Ration 5-6
Automatic	$13,665	$3,051	$30.51	$.051	$.069
Grinder mixer	11,642	2,647	26.47	.044	.059
Auger wagon					
From silo	9,192	2,072	20.72	.035	.046
From bunker	11,212	2,548	25.48	.042	.057

[a]Sources for Tables 55-59 are Tables 33-49.

Table 56. Feed distribution system cost for 250 head of cattle

System type	Investment	Annual cost	Cost/ head	Cost/lb. of gain	
				Ration 1-4	Ration 5-6
Automatic	$21,284	$4,707	$18.82	$.031	$.042
Grinder mixer	19,457	4,450	17.80	.030	.040
Auger wagon					
From silo	15,087	3,179	12.72	.021	.028
From bunker	17,927	3,875	15.50	.026	.034

Table 57. Feed distribution system cost for 500 head of cattle

System type	Investment	Annual cost	Cost/ head	Cost/lb. of gain Ration 1-4	Cost/lb. of gain Ration 5-6
Automatic	$42,568	$9,154	$18.31	$.031	$.041
Grinder mixer		NOT APPLICABLE			
Auger wagon					
From silo	29,260	6,324	12.65	.021	.028
From bunker	31,660	6,889	13.78	.023	.031

Table 58. Feed distribution system cost for 1000 head of cattle

System type	Investment	Annual cost	Cost/ head	Cost/lb. of gain Ration 1-4	Cost/lb. of gain Ration 5-6
Automatic	$83,937	$18,318	$18.32	$.031	$.041
Grinder mixer		NOT APPLICABLE			
Auger wagon					
From silo	47,720	10,032	10.03	.007	.009
From bunker	71,720	15,792	15.79	.011	.014

Table 59. Feed distribution system cost for 2500 head of cattle

System type	Investment	Annual cost	Cost/ head	Cost/lb. of gain: Ration 1-4	Cost/lb. of gain: Ration 5-6
Automatic	$209,644	$45,907	$18.36	$.031	$.041
Grinder mixer		NOT APPLICABLE			
Auger wagon					
From silo	94,350	19,789	7.92	.013	.018
From bunker	118,350	24,483	9.95	.016	.021

Table 60. Total pounds of gain for each of the five levels of cattle feeding for cattle gaining 600 pounds/animal and 450 pounds/animal

Gain/animal	Ration type	Total number of head				
		100	250	500	1000	2500
		Total pounds of gain				
600 lbs	1-4	60,000	150,000	300,000	600,000	1,300,000
450 lbs	5-6	45,000	112,500	225,000	450,000	1,125,000

5. select between the two methods of storing corn if corn is part of the ration from Tables 50 through 54 and record its cost;
6. find the supplement cost from Tables 50 through 54[1] and record its cost;
7. select the feed distribution system, which fits your feed storage system, and obtain its costs from Tables 55 through 59.

For example, assume a producer plans on feeding 100 head of cattle per year ration number one. The total weight gain associated with feeding 100 head of cattle ration one is 60,000 pounds. The producer chooses among the three alternatives of storing roughages and picks the higher moisture structure. There is no ration or storage cost for corn, as there is no corn required in ration number one. The producer next chooses the feed distribution system and picks the automatic system.

The total feed distribution system cost per pound of gain would be:

$.273	roughage cost in high moisture structure, Table 50
.065	supplement cost, Table 50
.069	feed distribution system cost, Table 36
$.407	cost per pound of gain

60,000	pounds total gain, Table 60
x $.407	cost per pound of gain from above
$24,420	feed distribution and storage cost

These calculations may be computed for any combinations of number of cattle fed, ration, weight gain of cattle, storage alternatives, and feed distribution systems.

---

[1]One alternative was used to store supplement. This cost is included in the feed distribution system.

CHAPTER V: SUMMARY AND CONCLUSIONS

Summary

Cattle feeding is an important part of Iowa's agricultural economy. The agricultural and non-agricultural sectors benefit from Iowa's cattle industry. This study evaluated one aspect of feeding cattle, the feed distribution system.

The objectives of this study were:

1. to determine what kinds of systems Iowa cattle feeders are now using to store and distribute feedstuffs,
2. to establish costs for storing cattle feedstuffs in various storage structures,
3. to develop investments and costs for various feed distribution systems,
4. to construct feed distribution system budgets,
5. to make recommendations about optimal feed storage and distribution systems by size of feedlot.

Farm visits were conducted in the Spencer, Iowa area to develop background material for the study. A telephone survey was made of a random sample of cattle feeders to determine systems currently in use. The most popular types of feed distribution systems included grinder mixers, auger wagons, and automatic systems.

Factors which may affect the type of feed distribution system a farmer selects include the number of cattle to be fed, available capital, existing facilities, and rations to be used.

Silo capacities and storage costs were determined through a letter of inquiry sent to mid-western silo manufacturers. Grain storage costs were determined by contacting several grain storage bin erection firms, with the most often quoted price being used. Existing facilities found on the farm play an important role in determining what types of storage structures the cattle feeder utilizes on the farm.

Investment and costs were calculated for the various feed system types. These costs were calculated on a per head basis and per pound of gain. Total investment increased as cattle numbers became larger, but the cost per pound of gain for the larger feedlots was less than for the smaller feedlots due to economies of scale.

Feed distribution systems enterprise budgets were developed by combining the storage structure and ration costs, with the feed distribution systems cost. Budgets were developed for five levels of cattle feeding; namely, 100, 250, 500, 1000, and 2500 head.

For each size level, six common rations were specified. Costs were developed for alternate storage structures associated with each ration. The three common feed distribution systems could be selected to be combined with the appropriate feed storage structure. This made it possible to tabulate total costs for the ration, storage of the ration and distribution of the ration for each level of cattle feeding.

Conclusions

Selection of the least cost feed distribution and ration storage system for a producer currently feeding cattle may be difficult, as

existing facilities and rations used may modify the results and interpretations of this study.

Therefore, in this section we will assume a producer constructs his feed distribution and ration storage system from the beginning. The cattle producer will also be limited to a typical ration used in feeding cattle. In this instance ration 2, which utilizes 3 tons corn silage, 37 bushels corn, and 261 pounds of supplement, will be used.

Based upon the data gathered as shown in Tables 8 through 60, the following conclusions may be drawn about feed distribution and ration storage systems costs for each level of cattle feeding. All costs are shown in cost per pound of gain per animal.

100 head cattle

The most economical silage storage system was the bunker method with a cost of $.114 per pound of gain, followed by the concrete silo costing $.120 and the high moisture structure costing $.161.

The most economical corn storage system was the grain bin costing $.165 per pound of gain, followed by the high moisture structure costing $.187.

The most economical feed distribution system was the silo to unloader wagon costing $.035 per pound of gain, followed by the bunker to unloader wagon costing $.042, the grinder mixer costing $.044, and the automatic system costing $.051.

Therefore, the most economical method was the vertical silo silage storage, grain bin corn storage, and vertical silo to unloader wagon feed

distribution system. Total cost for this system is:

$.120	silage storage and ingredient cost
.165	grain storage and ingredient cost
.035	distribution system cost
.056	supplement cost
$.376	cost per pound of gain
60,000	pounds gain
x $.376	cost per pound of gain
$22,560	cost for 100 head

250 head cattle

The most economical silage storage system was both the bunker and concrete silo, each costing $.108 per pound of gain, followed by the high moisture structure costing $.122.

The grain bin was the most economical corn storage system costing $.165 per pound of gain, followed by the high moisture structure of $.187.

The feed distribution systems costs were the silo to unloader wagon costing $.021 per pound of gain, bunker to unloader wagon $.026, grinder mixer $.030, and automatic $.031.

Therefore, the most economical method was the silo silage storage, grain bin corn storage, and silo to unloader wagon feed distribution system. Total cost for this system is:

$.108	silage storage and ingredient cost
.165	grain storage and ingredient cost
.021	distribution system cost
.056	supplement cost
$.350	cost per pound of gain
150,000	pounds of gain
x $.350	cost per pound of gain
$52,500	cost for 250 head

500 head cattle

The most economical silage storage system was the concrete stave silo costing $.105 per pound of gain, followed by the bunker costing $.108 and the high moisture structure costing $.118.

The grain bin was the most economical corn storage system costing $.163 per pound of gain, followed by the high moisture system costing $.176.

Feed distribution costs were the silo to unloader wagon costing $.021 per pound of gain, the bunker to unloader wagon costing $.023, and the automatic system costing $.031.

Therefore, the most economical method was the silo silage storage, grain bin corn storage, and silo to unloader wagon distribution system. Total cost for this system is:

$.105	silage storage and ingredient cost
.163	grain storage and ingredient cost
.021	distribution system cost
.056	supplement cost
$.345	cost per pound of gain
300,000	pounds of gain
x $.345	cost per pound of gain
$103,500	cost for 500 head

1000 head cattle

The most economical silage storage system was the silo costing $.103 per pound of gain, followed by the bunker costing $.106 and the high moisture structure costing $.117.

The grain bin was the most economical corn storage system costing $.161 per pound of gain, followed by the high moisture structure costing

$.175 per pound of gain.

The feed distribution system costs were $.017 per pound of gain for silo to unloader wagon, $.027 for bunker to unloader wagon, and $.031 for the automatic system.

The most economical system, therefore, was the silo silage storage, grain bin corn storage, and silo to unloader wagon feed distribution system. Total cost for this system is:

$.103	silage storage and ingredient cost
.161	grain storage and ingredient cost
.017	distribution system cost
.056	supplement cost
$.337	cost per pound of gain

600,000	pounds of gain
x $.337	cost per pound of gain
$202,200	cost for 1000 head

2500 head cattle

The most economical silage storage system was the bunker costing $.101 per pound of gain, followed by the concrete stave silo costing $.102 and the high moisture structure costing $.117.

The grain bin was the most economical corn storage system costing $.160 per pound of gain followed by the high moisture structure costing $.174.

Feed distribution systems costs were $.013 per pound of gain for the silo to unloader wagon, $.017 for the bunker to unloader wagon, and $.031 for the automatic distribution system.

Therefore, the most economical method was the concrete stave silo silage storage, grain bin corn storage, and silo to unloader wagon

distribution system. Total cost for this system is:

$.102	silage storage and ingredient cost
.160	grain storage and ingredient cost
.013	distribution system cost
.056	supplement cost
$.331	cost per pound of gain

1,500,000	pounds of gain
x $.331	cost per pound of gain
$496,500	cost for 2500 head

Feed distribution systems and ration storage methods which are the most economical, may not be the type commonly used in each level of cattle feeding. For example, the data presented in this study favor silo storage for silage for large producers, while actually, large producers normally use horizontal bunkers for silage storage.

There are several reasons for this. The bunker system may be faster to distribute the feedstuffs to the animals than the silo method is. A payloader may unload silage from a bunker faster than a mechanical silage unloader does for a silo.

The amount of labor may make a difference. Is there more labor needed in the silo method versus the bunker, or vice versa?

Another factor may be the differences in storage losses between the silo and bunker method. Typically, the vertical silo preserves silages better than the horizontal bunker. The data in this study adjust storage amounts needed for the animals by typical storage losses found in Appendix Table B-1. Even though the losses are from storing the silage in a bunker is costing the producer money, it is a cost which is difficult to see. On a day by day basis, the producer can't see the poorer weight gains

associated with feeding a possible lower quality silage from a bunker, versus a silo.

Again it is imperative to realize there are many variables which cause a farmer to choose a particular feed distribution system. Existing facilities, the number of cattle fed, type of ration fed, management ability, and available capital are all items which must be considered before a choice is made on which feed distribution system to choose.

Table 61. Ration ingredient prices

Ingredient	Price	Unit
Silage	$16.00	Ton
Corn	2.45	Bushel
Hay	50.00	Ton
Haylage	25.00	Ton
Supplement	.13	Pound

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APPENDIX A: CATTLE FEEDING TELEPHONE SURVEY

Name _____ Interviewer _____

Address _____

_____

	Date	Time
1st call	_____	_____
2nd call	_____	_____
3rd call	_____	_____

Phone 168-9-1 _____ _____ Reason for not Cooperating:
area code number

_____

Hellow, is this the _____ residence? My name is _____ and I'm working for the Department of Economics at Iowa State University in Ames. We're conducting research on cattle feeding systems in Iowa. We are randomly contacting farmers within the state in order to find out what type of cattle facilities they use on their farms. The data gathered will enable us to better advise Iowa cattlemen on their cattle feeding operations. All information will be kept confidential and used only for research purposes. This survey does not request any financial information. Your assistance will be greatly appreciated. May we begin?

Did you finish any cattle for market slaughter during 1978?

yes _____ no _____
continue stop

1) The first questions concern the types of cattle you feed and how many. (1-21)[1]

Did you feed any _____	yes	no	How many _____ did you sell for slaughter in 1978	What grade were they finish to 1-4	What months of year were the _____ placed on feed 1-13	Were these _____ fed on 1) 2) 3)
Hfr. calves						
Str. calves						
Hfr. yearlings						
Str. yearlings						

1) Prime
2) Choice
3) Good
4) Sold as yearling

1) January
2) February
3) March
4) April
5) May
6) June
7) July
8) August
9) September
10) October
11) November
12) December
13) Continuous

1) own farm
2) rented farm
3) combination

[1]The numbers in parentheses here and on the following pages refer to the text questions.

2) The next group of questions deal with feeding practices.

A) How many times are cattle fed each day? _____ (22)

B) How many years have you fed cattle on your present farm? _____ (23)

C) What nutrient and feed sources are included in your normal starting ration?

D) What nutrient and feed sources are included in your normal finishing ration?

E) What type of feedlots do you have? (24)

_____ open lot

_____ feedling apron

_____ all concrete

_____ no concrete

_____ wind break

_____ building

_____ solid floor confinement

_____ slatted or flush floor confinement

_____ other

3) The next series of questions are about storage facilities.

A) Do you have any haylage, silage or roughage storage facilities on your farm, which you still use?

_____ yes (continue) _____ no (next question) (25)

What type	number	total capacity tons
concrete stave silos	_____	_____
oxygen limiting silos	_____	_____
- poured concrete	_____	_____
- steel	_____	_____
bunker	_____	_____
other	_____	_____

B) What type of Corn Grain Storage do you have? (37)

_____ ear corn cirb

_____ high moisture structure

_____ take to town

_____ acid treatment

_____ other

C) What type of Supplement Storage do you have?

_____ (38) _____ capacity in tons _____ (39) _____

D) What type of Hay Storage do you have? (40)

_____ barn mow

_____ stacked with overhead protection

_____ stacked without overhead protection

_____ other protection

E) What type of bale is used for hay? (41)

_____ small bales

_____ large round bales

_____ stacks

_____ other

4) The next series of questions concern the feed distribution system.

A) What type of feed distribution system do you have? (42)

	Fence line bunks	In lot bunks
_____ push button Auger from silo to		
_____ silo to unloader wagon to		
_____ bunker to unloader wagon to (if bunker go to b)		
_____ grinder mixer to		
_____ other		

B) How do you extract feed from the bunker? (43)

_____ payloader

_____ tractor with loader

_____ skid steer

_____ silage slicer

_____ movable fence

_____ other _____

C) How are the roughages and concentrates mixed? (44)

_____ in the feed bunks

_____ in a feeder-mixer wagon

_____ in a grinder mixer

_____ auger system at the feed storage facility

_____ other _____

D) Was your feed storage and distribution system? (45)

_____ on farm when moved on and still utilized

_____ designed feed system first and then determined the number of cattle which can be fed by it

_____ first determined number of cattle to be fed and then designed system

5) The next series of questions concern crops grown on your farm and labor available. (46-47)

A) How many acres of _____ did you raise on (your own) (rented ground).
crop

Crop	Acres Owned	Acres Rented
Corn	_____	_____
Silage	_____	_____
Haylage	_____	_____
Hay	_____	_____
Oats	_____	_____
Rotated bast	_____	_____
Perm bast	_____	_____

B) What type of lease do you have with the rented ground? (68)

_____ crop share

_____ cash only

_____ crop and cash

_____ livestock share _____ detail

_____ other _____

6) The next questions concerns available labor on farm? (69-70)

Labor

A) What members of your family work on your farm?

yes	no		40 or more hrs. full time	20-40 hrs. half-time	less 20 hrs. < 1/2 time	hrs./day feeding cattle
___	___	operator	_____	_____	_____	_____
___	___	spouse	_____	_____	_____	_____
___	___	children _____#	_____	_____	_____	_____

B) Other than family members, do you have any paid help? (82)

_____ yes

_____ no

		40 or mor hrs. full time	20-40 hrs. half-time	less 20 hrs. < 1/2 time	hrs./day feeding cattle
Person	1)	_____	_____	_____	_____
	2)	_____	_____	_____	_____
	3)	_____	_____	_____	_____
	4)	_____	_____	_____	_____

APPENDIX B: SILO INVESTMENTS AND ANNUAL COST TABULATIONS

Table B-1. Estimated average silage storage losses under good management

Type of silo	Percent of loss	
	Average	Range
Gas tight	4	1-10
Concrete stave	6	1-11
Bunker or trench	10	1-15

Table B-2. Annual silo ownership costs as a percentage of original cost[a]

Item	Air-tight (percent)	Concrete stave or (percent)	Bunker trench (percent)
Depreciation	5	5	6.67
Interest	4.5	4.5	4.50
Repairs	1	1.5	1.5
Taxes and insurance	1	1	1
	11.5	12	13.67

[a]Estimated life of air-tight silos, 20 years; concrete stave silos, 20 years; bunker or trench silo, 15 years. Actual life of silo may be longer than estimated if adequately maintained. Obsolescence may reduce the economic life.

Table B-3. Estimated upright silo capacity in tons for corn silage at 65 percent moisture[a]

Silo height, feet	Silo diameter, feet				
	18	20	22	24	30
40	202	249	300	356	557
50	227	342	416	493	771
60	361	445	538	638	1000
70				790	1235
80				949	1478

[a]Tonnage will vary at different moisture contents, but dry matter content will be about the same. The actual amount stored may vary in different silos, depending upon moisture content, distribution, and fineness of cut. To accurately determine amount in a silo (for buying or selling), weigh the silage after removal from the silo.

Table B-4. Estimated upright silo capacity in tons for haylage at 50 percent moisture[a]

Silo height, feet	Silo diameter, feet				
	18	20	22	24	30
40	144	178	214	254	398
50	198	244	297	352	551
60	258	318	384	456	714
70				564	882
80				678	1056

[a]Tonnage will vary at different moisture contents, but dry matter content will be about the same. The actual amount stored may vary in different silos, depending upon moisture content, distribution and fineness of cut. To accurately determine amount in a silo (for buying or selling), weigh the silage after removal from the silo.

Table B-5. Approximate capacity for corn silage in trench or bunker silos with sides sloped outward 1½ inches for each foot of depth

Bottom width (feet)	Approximate tons per foot of length — Depth-feet				
	8	10	12	16	20
20	3.1	4.0			
30	4.6	5.9	7.1	9.6	
40	6.1	7.7	9.3	12.6	16.0
50	7.6	9.6	11.6	15.6	19.8
60		11.5	13.8	18.6	23.6
70			16.1	21.6	27.4
80			18.3	24.6	31.0
100				30.6	38.0

Table B-6. Approximate silo capacity and cost in Iowa

Silo type and size (feet)	Silo capacity: Corn silage (tons)[a]	Silo capacity: Haylage (tons)[b]	Cost: Silo	Cost: Unloader	Cost: Total
Concrete stave					
18 x 50	277	198	$ 9,189	$4,076	$13,265
18 x 60	361	258	10,802	4,103	14,905
20 x 50	342	244	10,244	4,175	14,419
20 x 60	445	318	12,194	4,198	16,392
20 x 70	567	428	14,152	4,224	18,376
22 x 50	414	296	11,466	4,368	15,834
22 x 60	538	384	13,764	4,379	18,143
22 x 70	665	474	16,236	4,416	20,652
24 x 50	493	352	13,115	4,636	17,751
24 x 60	638	456	15,990	4,647	20,637
24 x 70	790	564	18,605	4,676	23,281
24 x 80	949	678	21,707	4,708	26,415
26 x 60	764	546	18,274	4,725	22,999
26 x 70	958	684	21,863	4,752	26,615
26 x 80	1,159	828	25,946	4,779	30,725
28 x 60	865	618	20,999	4,896	25,895
28 x 70	1,077	769	24,848	4,925	29,773
28 x 80	1,294	924	29,606	4,954	34,560
30 x 60	1,000	714	23,277	5,145	28,422
30 x 70	1,282	882	27,115	5,165	32,280
30 x 80	1,478	1,056	31,812	5,176	36,988
Gas-tight					
20 x 50	342	244	22,992	10,219	33,211
20 x 60	445	318	25,985	10,219	36,204
20 x 70	567	428	27,543	10,219	37,762
25 x 65	832	594	31,857	10,911	42,768
25 x 80	1,056	754	39,941	10,911	50,852
Bunker[c]					
500 tons	500	355	9,502	3,494	12,996
750 tons	750	533	11,010	4,899	15,909
1000 tons	1,000	710	15,347	7,698	23,045
1500 tons	1,500	1,065	19,845	9,998	29,843
2500 tons	2,500	1,775	29,953	24,000	53,953
5000 tons	5,000	3,550	41,028	24,000	65,028

[a] .65 percent moisture.

[b] .50 percent moisture.

[c] Cost of unloader of bunker silos will vary with type of equipment used.

Table B-7. Investment cost per ton of silage storage capacity (silo and unloader)

Silo type and size (feet)	Corn silage	Haylage
Concrete stave		
18 x 50	$47.89	$ 66.99
18 x 60	41.29	57.77
20 x 50	42.16	59.09
20 x 60	36.84	51.55
20 x 70	32.41	42.93
22 x 50	38.25	53.49
22 x 60	33.72	47.25
22 x 70	31.06	43.57
24 x 50	36.00	50.43
24 x 60	32.35	45.26
24 x 70	29.47	41.28
24 x 80	27.83	38.96
26 x 60	30.10	42.12
26 x 70	27.78	38.91
26 x 80	26.51	37.11
28 x 60	29.94	41.90
28 x 70	27.64	38.72
28 x 80	26.71	37.40
30 x 60	28.42	39.81
30 x 70	25.18	36.60
30 x 80	25.03	35.02
Gas-tight		
20 x 50	97.11	136.11
20 x 60	81.36	113.85
20 x 70	66.60	88.23
25 x 65	51.40	72.00
25 x 80	48.16	67.44
Bunker[a]		
500 tons	26.00	36.61
750 tons	21.21	29.85
1000 tons	23.05	32.46
1500 tons	19.90	28.02
2500 tons	21.58	30.40
5000 tons	13.00	18.32

[a]Cost of unloader for bunker silos will vary with type of equipment used.

Table B-8. Annual cost per ton of corn silage for silos of different types of sizes

Silo type and size (feet)	Cost per ton[a]		
	Silo	Unloader	Total
Concrete stave			
18 x 50	$3.98	$2.65	$ 6.63
18 x 60	3.59	2.05	5.64
20 x 50	3.59	2.20	5.79
20 x 60	3.29	1.70	4.99
20 x 70	3.00	1.34	4.34
22 x 50	3.32	1.90	5.22
22 x 60	3.07	1.47	4.54
22 x 70	2.93	1.20	4.13
24 x 50	3.19	1.69	4.88
24 x 60	3.01	1.31	4.32
24 x 70	2.83	1.07	3.90
24 x 80	2.74	.89	3.63
26 x 60	2.87	1.11	3.98
26 x 70	2.74	.89	3.63
26 x 80	2.69	.74	3.43
28 x 60	2.91	1.02	3.93
28 x 70	2.77	.82	3.59
28 x 80	2.75	.69	3.44
30 x 60	2.79	.93	3.72
30 x 70	2.54	.73	3.27
30 x 80	2.58	.63	3.21
Gas-tight			
20 x 50	7.73	5.39	13.12
20 x 60	6.72	4.13	10.85
20 x 70	5.59	3.24	8.83
25 x 65	4.40	2.36	6.76
25 x 80	4.35	1.86	6.21
Bunker[b]			
500 tons	2.60	1.26	3.86
750 tons	2.01	1.18	3.19
1000 tons	2.10	1.39	3.49
1500 tons	1.81	1.20	3.01
2500 tons	1.64	1.73	3.37
5000 tons	1.12	.86	1.98

[a]Costs computed on the basis of one filling per year and do not include storage losses.

[b]Cost of unloader for bunker silos will vary with type of equipment used.

Table B-9. Annual cost per ton of haylage for silos of different types and sizes

Silo type and size (feet)	Cost per ton[a]		
	Silo	Unloader	Total
Concrete stave			
18 x 50	$ 5.57	$3.71	$ 9.28
18 x 60	5.02	2.86	7.88
20 x 50	5.04	3.08	8.12
20 x 60	4.60	2.38	6.98
20 x 70	3.97	1.78	5.75
22 x 50	4.65	2.66	7.31
22 x 60	4.30	2.05	6.35
22 x 70	4.11	1.68	5.79
24 x 50	4.47	2.37	6.84
24 x 60	4.21	1.83	6.04
24 x 70	3.96	1.49	5.45
24 x 80	3.84	1.25	5.09
26 x 60	4.02	1.56	5.58
26 x 70	3.84	1.25	5.09
26 x 80	3.76	1.04	4.80
28 x 60	4.08	1.43	5.51
28 x 70	3.88	1.15	5.03
28 x 80	3.84	.97	4.81
30 x 60	3.91	1.30	5.21
30 x 70	3.69	1.05	4.74
30 x 80	3.62	.88	4.50
Gas-tight			
20 x 50	10.84	7.54	18.38
20 x 60	9.40	5.78	15.18
20 x 70	7.40	4.30	11.70
25 x 65	6.17	3.31	9.48
25 x 80	6.09	2.60	8.69
Bunker[b]			
500 tons	3.66	1.77	5.43
750 tons	2.82	1.65	4.47
1000 tons	2.95	1.95	4.90
1500 tons	2.55	1.69	4.24
2500 tons	2.31	2.43	4.74
5000 tons	1.58	1.22	2.80

[a]Costs computed on the basis of one filling per year and do not include storage losses.

[b]Cost of unloader for bunker silos will vary with type of equipment used.